

Inventor: MACKLIN ET AL  
Serial No.: 10/069,011  
Filing Date: 03/14/2002  
Examiner: MERCADO  
Group Art Unit: 1745

REMARKS

This is a response to the Office action of December, 2005.

Claims 1-10 are present in the application.

The rejection of claims 1-6 under 35 U.S.C. 103(a) based on Miyabayashi et al. and Ikeda et al. has been withdrawn.

Claims 1-10 (new claims 7-10 were submitted with the RCE) are rejected under 35 U.S.C. 103(a) as being unpatentable over Miyabashi (sic) et al. in view of Zhou et al. (6,280,697) newly cited.

The Examiner has entered a new ground, including newly cited art, and has rejected claims 1-10 under 35 U.S.C. 103(a) as being unpatentable over Miyabayashi et al, in view of newly cited Zhou et al. (U.S. Patent 6,280,697 B1).

Miyabayashi et al. (U.S. Patent 4,945,014) was discussed in considerable detail in Applicants' amendment dated October 31, 2005 at the paragraph bridging pages 5 and 6 and the first full paragraph on page 6. The comments are repeated here for convenience of the Examiner:

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- "US 4,945,014 (Miyabashi) (sic) discloses a lithium cell where the anode comprises lithium and a carrier which is a

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carbonaceous material and a metal which can form an alloy with lithium. The carbonaceous material is described as being in the form of particles which are preferably 5 to 100µm in size. The particles are described as porous but there is no indication of why the particles are porous or whether the pores perform a purpose.

Miyabashi describes in column 7 several methods of forming the carrier for the anode of the cell. These typically involve mixing metal powder with the carbonaceous particles and molding or heating the powders. There is no indication that the metal enters the pores of the carbonaceous particles. Indeed, in method 7 (column 7 line 67 and example 7) the metal is explicitly coated onto the surface of the carbonaceous particles and forms a layer 0.1 to 30µm thick. This method renders any pores in the carbonaceous particles irrelevant. Thus, there is no appreciation of the use of pores in the carbonaceous particles for any particular purpose in Miyabashi."

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The Miyabayashi et al. system has the advantage of the high capacity of alloy forming metals and metalloids for storing lithium. However, it has the disadvantage of large volume changes on the insertion and removal of the lithium which results in the anodes decrepitating. The present invention meets this problem. Applicants contend that Miyabayashi et al. in view of Zhou et al, does not render the invention obvious for the reasons given below.

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The Examiner states that Zhou et al. citation teaches carbon nanotubes as an electrode material for a lithium battery. Applicants do not dispute this and have, in fact, already acknowledged that use of carbon nanotubes in the anode of a secondary lithium cell has been suggested in the art. See the first complete paragraph on page 2 of the present application.

The Examiner then states that it would be obvious to modify Miyabayashi et al's invention by employing carbon nanotubes. This statement, in itself, does not arrive at the present invention because parent claim 1 specifically recites that "the metal or metalloid is inside said nanotubes." It is clear that this claimed feature of Applicants' invention of providing an alloy-forming metal or metalloid inside the nanotubes is absent from the cited art.

The Examiner further draws attention to statements in Zhou et al, regarding the ability of the nanotubes to accommodate intercalated materials such as Li<sup>+</sup> ions. Thus, Zhou et al. states that mechanical treatment of nanotubes facilitates Li<sup>+</sup> diffusion into the nanotubes and that considerable amounts of Li<sup>+</sup> ions can readily diffuse into them through opened ends and perhaps other defect sites. This is discussed in column 6, lines 40-59 of Zhou et al.

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Applicants contend that the above statements do not detract from the patentability of the present claims but rather confirm what is taking place in the present invention. Thus, the present invention requires  $\text{Li}^+$  to gain access to the inside of the nanotubes in order to be able to form an alloy with the metal or metalloid situated inside and within the nanotubes. Zhou et al. is, therefore, merely reporting what is implicit in the present invention: that  $\text{Li}^+$  must have access to the inside of the nanotubes. The improved capacity identified by Zhou et al. is a consequence of using damaged SWNT's (single walled nanotubes) and has no connection with the distinguishing feature of the present invention, i.e., providing defined alloy-forming metal or metalloids inside nanotubes.

In neither of Miyabayashi et al. or Zhou et al. is there any indication to the skilled person that he (or she) should provide a defined metal or metalloid inside nanotubes. If one were to read Miyabayashi and Zhou together, he/she would employ the nanotubes of Zhou et al. as the carbonaceous material of Miyabayashi et al., but wherein the metal or metalloid is outside the nanotubes, i.e., different from the present invention. There is no incentive or motivation in either document that the skilled person should employ the metal or metalloid inside nanotubes, thereby to meet the problem referred to on page 1 of the present specification, of

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volumetric changes and structural damage that arises when a cell with a lithium/metal or metalloid alloy anode is repeatedly cycled.

The Examiner has commented at the bottom of page 3 of the Office Action with reference to Zhou et al. that " . . . to the skilled artisan the metals of the lithium active material would resultantly diffuse into the nanotubes so as to be contained inside the nanotubes." This is true, but nothing is said or implied about providing an alloy-forming metal or metalloid inside the nanotubes to form an alloy with the lithium. Nothing in the citations tells the skilled person to provide the metal or metalloid inside the nanotubes; Zhou et al. is merely offering the skilled person another form of carbon, not a solution to the above-mentioned disadvantage of Miyabayashi et al.

In view of the foregoing, reconsideration of the application is requested and allowance of claims 1-10 is courteously solicited.

Respectfully submitted,

March 9, 2006  
Date

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